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SCIENCE

FRIDAY, DECEMBER 2, 1910

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ADDRESS AT THE DEDICATION OF THE ENTOMOLOGY AND ZOOLOGY BUILDING OF THE MASSACHUSETTS AGRICULTURAL COLLEGE¹

WHEN Professor Fernald began to teach entomology in the Maine State College at Orono, in 1872, there was only one other teacher of the subject in the United States, and that was Dr. Hagen, at Harvard, who had only an occasional student. Of earlier attempts to teach entomology on this side of the Atlantic there is little of record. W. D. Peck lectured at Harvard in the earlier years of the last century, and after 1831 T. W. Harris, while librarian of Harvard, had a private class in entomology, meeting one evening a week, and on Saturday afternoons went with his class in good weather on a ramble. Colonel Higginson writes: "Doctor Harris was so simple and eager, his tall spare form and thin face took on such a glow and freshness; he dwelt so lovingly on antennæ and tarsi and handled so fondly his little insect martyrs, that it was enough to make one love this study for life beyond all branches of natural science."

Teachers of natural history of those days had to cover botany, zoology, geology, human physiology, chemistry and natural philosophy. Collections and apparatus were practically non-existent. The publication of Harris's "Insects Injurious to Vegetation" in 1841, classic though it was, aroused no great interest in the study of insects, and it remained for Packard's "Guide to the Study of Insects," published in Salem in 1869 and written by a young and enthusiastic worker inspired by

¹ November 11, 1910.

Agassiz's training, to place entomology in America on a footing so that the subject could be competently studied and taught. The influence of Louis Agassiz in fact, perhaps even more than is generally realized, was enormous in the development of interest in natural history in America, and entomology no less than the other branches of the subject felt its stimulating effect. Moreover, the Smithsonian Institution in those older days under Joseph Henry did much by the publication in its "Miscellaneous Collections" of the works of Morris, Osten Sacken, Loew and Le Conte to help the labors of the earlier group of workers.

So we find the elder Fernald beginning to teach entomology at the Maine State College in 1872, and a year later J. H. Comstock began to teach it at Cornell. Fernald, however, was professor of natural history and he had to teach all sorts of things, while Comstock was confined to entomology and invertebrate zoology. Thus, while Fernald was one of the early teachers of entomology, Hagen was really the first professor of this subject with Comstock as second. But it is not my plan to discuss precedence in this direction. I wish to show how recent are the beginnings of the study and how rapidly it has advanced. As it happens, I was Comstock's first student, and we began to work together in a little cramped room in the autumn of 1873, with little material, few books and a poor microscope for our equipment. At the Agassiz Museum, Hagen had his excellent library and good collection, and he had Crotch and Schwarz and Hubbard and, a little later, Samuel Henshaw working with him. Fernald was working single-handed off in Maine. A few economic entomologists were busy—Fitch in New York, Riley in Missouri, Le Baron in Illinois and Glover in Washington. The systematic workers and those

who studied the habits of insects were more numerous—Le Conte, Horn, Osten Sacken, Lintner, V. T. Chambers, E. T. Cresson, S. H. Scudder, W. H. Edwards and his colleague T. L. Mead, Henry Edwards, A. R. Grote and his colleague Coleman T. Robinson, P. R. Uhler, H. F. Bassett, R. H. Stretch, F. G. Sanborn, S. S. Rathvon, Cyrus Thomas, H. C. McCook, G. R. Crotch, H. Behr, C. Zimmerman, George Dimmock, C. S. Minot, P. S. Sprague, F. Blanchard, C. A. Blake, Edward Norton, H. Shimer, T. Meehan, E. D. Cope, E. P. Austin, J. Behrens, J. H. Ridings, A. J. Cook, W. V. Andrews, Edward Burgess, L. F. Harvey, F. H. Snow, G. Lincecum, J. H. Emerton, Mary E. Murtfeldt, G. M. Dodge, C. R. Dodge, Thomas G. Gentry, H. K. Morrison, A. S. Fuller, E. L. Graef, and, across the border in Canada, Abbé Provancher, William Saunders, Rev. C. J. S. Bethune, William Couper and E. Baynes Reed were about all.

And it must be remembered that nearly all of these men had had no training and were scientifically untaught; nearly all were engaged in professions or in business, and that entomology was but a side issue and not the sole interest of their lives—in fact, with many of them it was simply an amusement, a fad. But I do not intend to detract from the value of their work. They and their few predecessors laid a strong systematic foundation for the work which has been done since, and for that which is still to come. It should be pointed out, however, that, systematically speaking, whole groups of the North American entomological complex were unknown. The Coleoptera and Lepidoptera and certain families in the Diptera and Hymenoptera had been studied by these men, but a field of unknown greatness remained unexplored.

Something must be said also of the influ-

ence of the unusual personality of some of these men in attracting others to the study. I have in mind especially Rev. J. G. Morris and Henry Ulke, neither of whom is mentioned in the list; Morris because at that period he had stopped publishing and Ulke because he had not published at all. Both of these men, rarely attractive, lived long, Morris dying in 1895 at the age of ninety-two and Ulke in the present year at eighty-nine, and both of them undoubtedly made entomologists of others by their personal charm and enthusiasm.

There were then in 1873 three teachers of entomology, two of them just beginning, three state entomologists, one of them (Fitch) already at the end of his work, a government entomologist who, on account of his mental make-up, was adding little to the progress of the science, and a small body of amateur entomologists engaged in all sorts of occupations, but whose systematic work as a whole compared favorably in quality with that of the workers of other countries. The *Canadian Entomologist* had been started, and the American Entomological Society was publishing good entomological papers.

At the present time, after thirty-seven years, what a change is to be seen! In the place of the few score self-trained entomologists, there is now an army. The American Entomological Society is still in existence, and publishes, in addition to its *Transactions*, an admirable entomological journal, *Entomological News*. The Entomological Society of Washington has been founded, with its quarterly *Proceedings* now well along in its twelfth volume. The Albany Entomological Society, the New York and Brooklyn societies, the California Entomological Society, the Society of Southern Economic Entomologists and the great Association of Economic Entomologists with its list of foreign members in all

parts of the world and its universally-read *Journal of Economic Entomology*, and, latest of all, the Entomological Society of America with its large list of members and fellows and its entirely competent annals and its representation the present year at the first International Entomological Congress—all have sprung into healthy and progressive existence since those days.

In place of the two active state workers in economic entomology, Le Baron in Illinois and Riley in Missouri, and of the single government entomologist, there is now in practically every state in the union an efficient entomological staff composed of trained men; and at Washington there is a corps connected with the Bureau of Entomology comprising six hundred and twenty-three individuals, of whom one hundred and thirty-one are trained entomologists. In certain states, notably California, there are even county and district entomologists. It is safe to say that in 1873 there were spent by states and the general government for entomological work not to exceed ten thousand dollars a year. On the other hand, the amount spent by states and the general government for this work at the present time much exceeds one million dollars a year. As late as 1877, immediately following the disastrous invasions of the Rocky Mountain locust into Colorado, Kansas and western Missouri, and which brought about a loss certainly equaling two hundred millions of dollars and reduced a large population to the verge of starvation, it was with the utmost difficulty that Riley and his colleagues were able to secure from congress an appropriation of eighteen thousand dollars to start the United States Entomological Commission on its work of investigation of the causes of the outbreak and the remedies to be used in case of future invasions. A conference of the governors of

the various western states and territories asked congress for a commission of five experts and an appropriation of twenty-five thousand dollars, but congress scaled this down to three experts and an appropriation of eighteen thousand dollars. Within very recent years, however, congress has appropriated almost without discussion such large sums as two hundred and fifty thousand dollars for the investigation of the cotton boll weevil and three hundred thousand dollars for the investigation of the gipsy moth and the brown-tail moth, while New Jersey has spent more than a hundred thousand dollars on the mosquito work, and Massachusetts alone more than a million on the gipsy moth, the latter sum covering the work of a number of years. It is safe, in fact, to estimate that there are in the neighborhood of five hundred scientifically trained entomologists holding official positions in this country at the present time, as against five thirty-seven years ago.

That with our rapidly increasing population a certain part of this growth should have occurred would have been quite to be expected, yet no such growth has occurred elsewhere, and we must search for other explanation than the one of normal increase. The first great impetus came with the organization of the state agricultural experiment stations in the spring of 1888 under the act of congress known as the Hatch act. In a short time twenty-eight experiment station entomologists were appointed. It was difficult to find the right men, but Fernald, Comstock and A. J. Cook had been lecturing to slowly increasing numbers of students, and the places were gradually filled and nearly all of them well filled. Most of the appointees found that they had to do much teaching work, and they had to build up libraries and collections, so that there was little time

for research work; but there were twenty-eight teachers thrown into the field, for the most part young and enthusiastic men, and through their efforts began a sudden increase in interest in entomology, and year after year their graduates and those of other teachers who had been added to their number have rapidly increased the number of working entomologists and of those possessing a trained interest in the study.

Shortly after these newly appointed experiment station workers took their places and began their labors, the gipsy moth was discovered in New England. It is due to Mrs. Fernald's accurate knowledge of the Lepidoptera that this insect was identified with the destructive European pest as early as it was; and this determination at once made it evident that strenuous efforts must be made to check the spread of the species. The rapid increase of this pest and the remarkable work carried on in the state of Massachusetts during the next ten years attracted the minds of the people of the country towards economic entomology as almost never before.

A few years later the San Jose scale was discovered in the eastern United States. The tremendous effect of the spread of this most injurious species upon the popular estimation of the value of entomological knowledge can hardly be overestimated. This spread alone is responsible probably for more legislation in this country and in other countries than all the other features of entomology combined. The San Jose scale literature published in the last sixteen years covers hundreds of thousands of pages, and hundreds of thousands of dollars have been lost through the work of the insect. But through the operation of new state laws many additional entomologists have been employed, and through their work millions of dollars have been saved.

The discovery in 1894 by Smith, Kil-

bourne and Salmon that Texas fever in cattle is carried by a tick, the discovery by Ross in 1898 that malaria is carried by certain mosquitoes, the discovery by Reed, Carroll and Lazear in 1900 that yellow fever is carried by a mosquito, and the later numerous discoveries of the rôle of insects in the carriage of diseases of man and animals have still further intensified public interest in entomology and have shown anew the importance of entomological education. Here economic entomology has touched a new side of human interest; it is the health of man and not the preservation of his property that is concerned, and the interest, therefore, has become a more vital one.

In 1894 the Mexican cotton boll weevil was discovered within the territory of the United States, and its spread to the north and east year after year has presented an enormous problem in economic zoology. The tremendous damage it has done and the fears it has aroused in other cotton-growing countries have threatened a disturbance in the balance of trade for the entire world. The investigation which has been carried on has been liberally supported by the general government, and many trained men have been employed in the work.

The present commanding position which the United States holds in entomology and the wide-spread interest felt in all entomological questions, the increased support of the government in this direction, and the increased attention given to education in economic zoology, are then mainly due to the establishment of the experiment stations, to the advent of the gipsy moth, to the spread of the San Jose scale in the east, to the discovery of the carriage of disease by insects and to the remarkable and disastrous spread of the cotton boll weevil throughout the south. There are

many other causes, such as the recent very great development of interest in the practical handling of the parasites and predatory enemies of injurious species, but these need not be detailed at this time. I have said enough perhaps to explain why there are so many trained entomologists at present and why the agricultural colleges are training so many more; and that brings us to the immediate question of the training of economic zoologists.

In an address on "The State and Zoology" given at Baltimore in December, 1900, I called attention to the fact that university teachers should make a study of the markets for the brains and training of their students; they should study the conditions of those markets and their needs. I showed that the men in charge of university departments of scientific work should keep closely in touch with the government work along similar lines; that they should be encouraged to do so by the government; that the government should employ their services where they can be of use, and that they themselves should be able with the intimate knowledge acquired by official association or by close investigation of government work, to lay out lines of study which will fit their students to take a hand in government work. This, I am glad to say, has been done by several of the teachers of zoology in the agricultural colleges, and by none more successfully than by the Fernalds, of the Massachusetts Agricultural College. The men they have turned out have taken good rank among the experts of the state and government departments. In the bureau of which I am the chief I have secured some of our most valuable workers from this college. Among them I may mention A. F. Burgess, W. E. Hinds, W. A. Hooker, A. W. Morrill, E. A. Back, H. M. Russell, H. P. Wood, J. H. Hyslop, F. H. Jones,

F. D. Couden, C. E. Hood, F. A. Johnston, S. S. Crossman, C. W. Hooker and A. I. Bourne; while among the others who have achieved prominence are Dr. E. P. Felt, state entomologist of New York; Mr. A. H. Kirkland, the former superintendent of the gipsy moth service of the state of Massachusetts; Mr. C. P. Lounsbury, the entomologist of South Africa; Mr. H. A. Ballo, the entomologist of the British West Indies; Mr. R. I. Smith, entomologist of the state of North Carolina; Mr. R. A. Cooley, the entomologist of the state of Montana; Mr. H. C. Gowdey, the entomologist of the African colony of Uganda.

These lists mean an excellent preparation. They mean that the Fernalds have studied the market for the brains of their students, and that they have turned out men fitted in every respect for their pursuit. I have always felt confidence in men coming from this laboratory, and that the work done by this department has been recognized in the erection of this building is a source of gratification to every one connected in any way with the men here or with the men who have gone out from here.

But after all this is only one of the evidences of the spread of education in this direction. Out in California four years ago the university at Berkeley erected a building exclusively for the department of entomology. I visited it only a month ago, and found Professor Woodworth surrounded by his corps of assistants, with the class rooms full of eager students and a general air of bustling energy and interest in the work. At Cornell, where Professor Comstock began, as I have shown, thirty-seven years ago in a small room with no assistants and no equipment, there is now a large department occupying spacious quarters in the new agricultural building erected by the state, with extensive libraries and large collections and a corps of six

professors, including Professor Comstock himself. Although the department is still that of entomology and invertebrate zoology, the entomology is by far the most important, and every one of the six professors is teaching entomology. There are also six assistants, of whom four are in biology, one in insect morphology and one in general entomology. The present year there is an enrollment of 565 in the various courses. This includes a registration of 375 in general biology and 190 in purely entomological courses.

In Illinois Professor Forbes has a building devoted entirely to entomology. It is not a very large building, but it is sufficiently commodious and the same interest in the work is shown. In strictly entomological courses this year there are 85 students, of whom 13 are graduate students working in advanced courses. The instructors are—one professor, one assistant professor and two laboratory assistants. Excellent courses are given, and good men are being turned out.

Out in Nebraska Professor Lawrence Bruner started in the autumn of 1888 with three students. During the past year (1909-10) there were 160 students in the first semester and 142 in the second semester in the school of agriculture, while in the college work there were 21 students throughout the year. At the date of present writing there are 23 students registered in college courses, while the school of agriculture has not yet started. Professor Bruner has one assistant professor and a laboratory instructor.

Such information as this might be continued for pages. This is sufficient, however, to indicate the advances that have been made and the sound condition in which we find instruction in economic zoology being carried on at the present time. It may be well to suggest here that if any

criticism is to be made of the training that economic zoologists are receiving in our institutions it is that sufficient stress is not laid upon the necessity of learning the methods of field work. A young man coming from a university or an agricultural college knowing his insects well and well fitted to teach, is at a great disadvantage in going into practical work if he has had no field experience, and also if he does not understand agriculture, horticulture and the most important art of meeting and handling men.

It will appear from what has been said that the Massachusetts Agricultural College has borne her full share, and the Massachusetts Agricultural College in this connection means Professor Charles H. Fernald, later with his son Henry. He came here in 1886, just before the founding of the agricultural experiment stations. His published works, both in purely scientific and economic directions, have stamped him as of the first rank. His work in connection with the magnificent efforts of the state of Massachusetts to control the gipsy moth and the brown-tail moth has been of the soundest character. The affection and respect shown for him by his students is indicated almost daily by those who have come to Washington, and is easily understood by one who, like myself, has been more or less closely associated with him for thirty years. I shall never forget the summer of 1880, when he and Mrs. Fernald spent some time in Washington working with Professor Comstock, who was at that time chief of the Division of Entomology, I myself being his assistant. Professor Fernald was a constant inspiration and he was also a constant delight on account of his overflowing humor. At that time pedlars and mendicants of different kinds were allowed access to the rooms, and it was a standing joke of the professor's, when the

door opened and one of these men came in, to jump to his feet, to appear to recognize him, shake his hand cordially, ask after his wife and children and the old folks at home, which almost invariably so confused the incomer that he turned around abruptly and left the room.

I understand that he is to retire now, I know of no one who has made quite so good a record, viewed from every point. A number of years ago I was riding with him along a country road in eastern Massachusetts, and he said to me, "Howard, I have been thinking about myself and of the little I have done, and I wonder whether after I shall have gone people will think of me as a systematic entomologist or rather as an economic entomologist." And I replied instantly, "You forget probably the biggest work you have done and the best work, and that is as a teacher." And is it not true? The memory of Professor Fernald will live after he goes, both as a systematist and as a strong economic entomologist, but, greater than either, as a teacher; and this building will be a visible monument to his work as long as it shall stand. May he live many more years to know and to enjoy the reputations which are being made and which shall surely continue to be made by the men he has taught.

L. O. HOWARD

U. S. DEPARTMENT OF AGRICULTURE

THE STATUS OF MODERN METEOROLOGY
INTRODUCTION

I AM transferring my work in meteorology from the U. S. Weather Bureau to other countries, after a continuous service for the government of twenty-one years, two in the Nautical Almanac and nineteen in the Weather Bureau, for reasons not relating to my official or professional duties. During this time numerous more or less detached researches have been published,